Hubs as a Solution to Traffic Congestion in Central Metropolitan Areas: The case of Ramses Square in GCR

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Abstract

Greater Cairo Region (GCR) is the largest metropolitan area on the African continent and the Arab world. It accommodates 16.1 million inhabitants representing 19% of Egypt's total population. Today, critical urban issues arise from the sheer size of the metropolis GCR and from its population density. Traffic congestion is on the top of these issues. This research focuses on the significant role that hubs (Multi Modal Platforms) can play in enhancing the GCR transportation infrastructure. Ramses square area in Cairo is selected to demonstrate a systematic solution to solve the problems resulted from the interference of multi uses activities and transportation modes in central areas of capital cities.

Keyword: Greater Cairo Region (GCR); Hubs; Urban Dynamics; Transportation

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1.0 Introduction

Greater Cairo Region (GCR) is the largest metropolitan area on the African continent and the Arab world. Its past has been influenced by a rich confluence of world trade and cultures and it stands as a bridge between East and West. The GCR is today the beating heart of Egypt. Around 19% of the country's population is living within its boundaries. Today, critical urban issues arise from the sheer size of the metropolis GCR and from its population density that is unique among large cities in the world. Traffic congestion is on the top of these issues, which needs prompt intervention to prevent saturation of the metropolis and the deterioration of living conditions (Elkouedi & Madbouly, 2007). Non-conventional solutions are needed to deal with such a critical issue. This research focuses on the significant role that hubs can play, as a non-conventional solution, in enhancing the GCR transportation infrastructure. The research deals with the interaction between the multiplicity of transportation modes and the urban dynamics related to the concentration of activities in the central districts in capitals. It focuses on how to solve the problems resulted from such interfere of activities and transportation modes in an integrated way. The Hub (Multi Modal Platforms) as a way of integration between the numerous activities and transportation modes leads to a quick connection and easy joint between many poles and axes of movement needed in the central districts with its energetic movements. Ramses square area in Cairo is selected to demonstrate clearly the phenomena that the research addresses.

2.0 Greater Cairo Region (GCR)

The GCR is the largest metropolitan area in Egypt and the second largest urban area in the Islamic World after Jakarta. It is the largest urban area in Africa and the world's 16th largest metropolitan area (Demographia, 2012). The GCR is a vast agglomeration that comprises the urbanized area of the Governorates of Cairo, Giza, Qalyobiya, Helwan, Sixth October and the eight new urban communities that surround, as shown in Fig. 1 & Table 1 (GOPP & UN-Habitat, 2011). In population terms GCR, at 16.1 million inhabitants in 2006, represented 19% of Egypt's total population. GCR is considered the most important urban agglomeration in Egypt (Sims, 2012).

Table 1.Population in GCR scope

Population within GCR boundary (Million inhabitants)		Area within GCR (Km^2)	% of Area within GCR
Total	16.1	3133	
Cairo Governorate	6.6	372	100%
Giza Governorate	3.3	119	100%
Helwan Governorate	2.5	1142	16%
6th of October Governorate	2.5	1352	4%
Qalyobeya Governorate	1.2	148	13%

(Source: Gopp estimates based on current CAPMAS, GOPP GIS databases)

To accommodate population growth, the urban area within the GCR has expanded

constantly since the 1952 revolution, as shown in Fig. 2. Currently, it encompasses 736 sq. km, six times larger than it was in the 1950s and twice as big as in the 80's. It currently represents approximately 23% of the GCR total area. The main agglomeration is heavily over-concentrated, where it accommodates 12.6 million inhabitants, accounting for over 78% of the GCR's population (GOPP & UN-Habitat, 2011). The GCR is considered by many observers to be a "primate" city, given its weight of numbers and the concentration of economic enterprises in it. It includes 55% of the nation's university places, 46% of total hospital beds, 40 % of pharmacies, 43% of public sector jobs and 40% of private sector jobs (Davis, 2006).

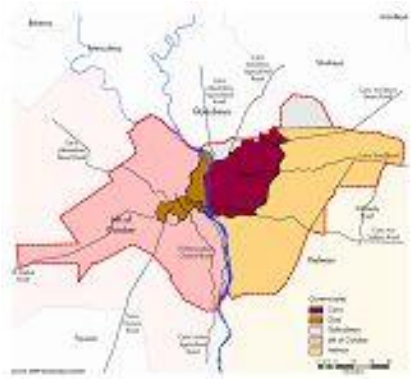

Fig. 1. Location map of Greater Cairo region (GCR)

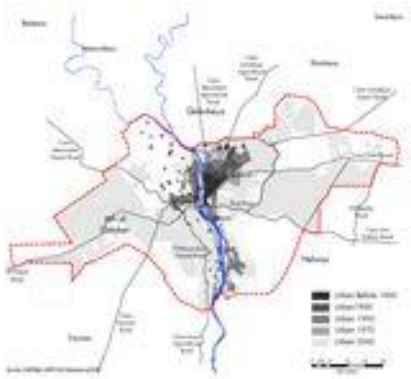

Fig. 2. Evolution of the Urban Mass

3.0 Conflict between Urban Dynamics &Transportation

The GCR is the preeminent transport center of Egypt accommodating over 20 million motorized person trips and 7 million non-motorized trips daily. Most of the transportation routes radiate from Cairo, connecting it with other major centers of the country and adding to its centrality. The lack of well-developed transportation and communication systems made it difficult to diffuse development from Cairo to other parts of the country, thus maintaining the primacy of Cairo (Rakodi, 1997). About 2/3 of all motorized trips are made by public transport through a combination of heavy rail, light rail, conventional buses, mini- and micro-buses, and taxis. It is, by any standards, overloaded. In response to this problem, privately owned passenger vans have begun to function all over the GCR. Although the road network represents nearly 25 percent of the total GCR area, its practical capacity is inadequate owing to many problems. Lack of maintenance, poor driving habits, low vehicle occupancy, bottlenecks, and lack of parking lots and garages are among the major problems that decrease the efficiency of the network. Furthermore, problems of traffic congestion and inadequate services have combined to increase environmental pollution. High levels of air pollution, due to suspended particulate matter and lead generated by traffic and industry

(especially cement manufacture), are exacerbated by wind-blown dust (WHO/UNEP, 1992). As a result of rapidly increasing population, and inadequate government responses, transportation conditions have deteriorated and the capacity of the GCR's transport systems to manage demand from the growing urban population is nearing the breaking point. The average travel speed in a business day does not exceed 10km/h, with many areas experiencing 5-6km/h during rush hours.

4.0 Transportation Hubs

Transportation hub can be defined as a location which handles several transport modes. Transport modes can be of various types such as tramway, bus, automobile, ship, pedestrian, railway, metro or rapid transit, coach, truck, airplane and ferry. Numerous advantages are expected from transportation hubs. They can offer high frequency of services in respect to other locations. The other advantage is the impressive development of an efficient distribution system simply because the transportation hubs can handle more traffic. Most of the transportation hubs make use of the shared transshipment facilities and so, the people can avail higher quality infrastructures at lower costs (Hubs.in, 2011). As Siemens (2011) argued, transport hubs are extremely important because the increasing flow of passengers and goods has to be managed within and between urban centers. As nodes, hubs must intelligently network various transportation systems so that people and goods can be transported in a safe, efficient, and environmentally sound manner. Hubs, as a network structure, allow a greater flexibility within the transport system, through a concentration of flows.

There is a number of best practice examples of transportation hubs worldwide, which worth to be mentioned. For example, the World Trade Center (WTC) Transportation Hub in Manhattan designed by architect Santiago Calatrava (WTC, 2012) and BOSTON John Fitzgerald Expressway - Central Artery (Fig. 3), known locally as the Central Artery (Wikipedia, 2012).

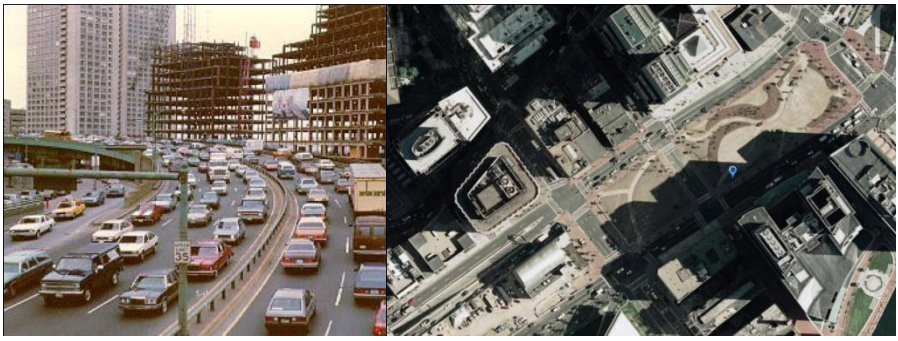

Fig. 3. Boston John Fitzgerald Expressway - Central Artery, before & after the project (BECT/AREP, 2009)

5.0 The Case of Ramses Square

Ramses square zone, located in the heart of Cairo is an obvious example for a multimodal nodal area. It integrates a variety of means of transport, as shown in Fig. 4, such as:

- National and regional stations of train
- A huge Metro station for two existing underground metro lines (line 1 and 2)
- Major road axes, such as the fly-over of 6th October and Ramses Street.
- Surface Tramway: linking this area with Heliopolis and Nasr city
- Bus, minibus and microbus stops and terminals (Ahmed Helmi Microbus terminal)

The following sections illustrate the adopted approach by an Egyptian and French Architectural offices/companies; BECT & AREP* for solving the problems of Ramses square zone using the concept of a transportation hub (Multi Modal Platform). This solution has won the first prize in the International competition for urban design and harmony, organized by the National Organization of Urban Harmony in Egypt, in 2009. It is worth mentioned that one of the authors of this research was the head of the planning team in the Egyptian counterpart.

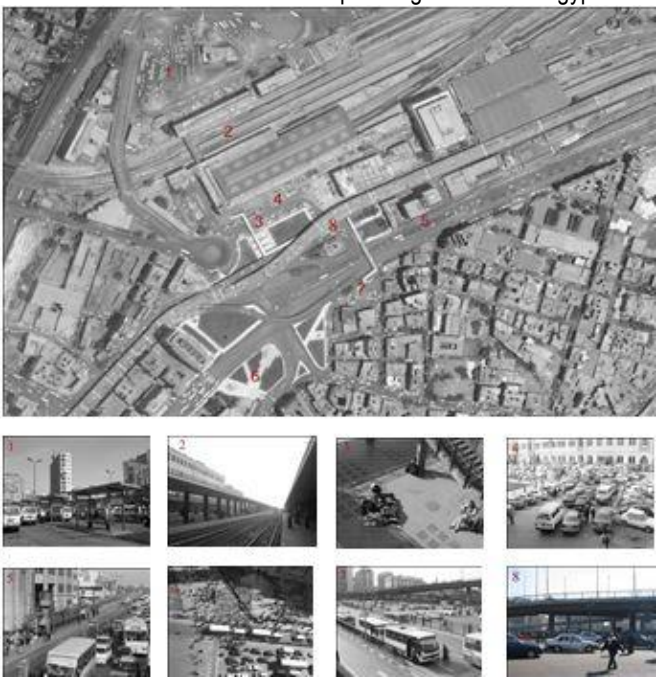

Fig. 4. Ramses sq. zone (Google earth map), 8 photos for different means of transport (BECT/AREP, 2009)

* BECT; Bureau Egyptien de Conseil Techniques is a consulting firm in Egypt, represented in the competition by Omar El Hussieny, Principal partner. And AREP is a public limited company in France represented in the competition by Etienne Tricaud, CEO.

6.0 Methodology

This research adopted a combination between theoretical and applied approach. The theoretical part includes literature review on the interaction between transportation modes and the urban dynamics in addition to "Transportation Hubs" in terms of concept and. The applied part focuses on Ramses Square in Cairo, where the concept of Hubs has been applied to solve the problems resulted from the interference of multi uses activities and transportation modes in such central area. It showed a multimodal transportation hub project with complete illustration: plans, sections, perspectives and sketchy analysis drawings to summarize the collective solution theme.

In addition to scarcity of data, application of such solution faced many limitations to reach its final phase of evolution, which can be summarized in the following:

- Removal of 6th October flyover, which was an intrepid decision
- Dealing with the complicated underground metro station both existing and planned ones (two lines, integrated with the new car tunnel, instead of 6th October flyover, and with the underground car parking).

6.1 Relieve downtown congestion:

A holistic vision of city transport system and services is indisputable for solving traffic overload problem in Cairo. It is crucial to rethink of the functionality and transport services in the city in addition to developing a strategy of railway transports at regional level. This can be realized through the following (BECT/AREP, 2009):

- Train stations: limiting of streamlining numbers of regional lines servicing Ramses station and Developing new stations in the suburbs, such as Shubra el Kheima Station (for Delta and Alexandria lines), Ain Shams Station (for Suez Canal cities' lines) and Giza (for the Higher Egypt lines) is to ensure the concept of decentralization (Fig. 5).
- Metro network, which is the most important means of transportation, with its currently operational overloaded two lines, added to it the 3rd line (nearly developed). Furthermore, an additional 3 more lines are under study.
- Tramway network: this network is old in Cairo, but now it is deteriorated. However, this mean of public transport is highly recommended; trustworthy it attracts lots of people in big cities such as Paris or Barcelona.
- Road network: this network is highly overloaded congested routes connected with 6th October fly-over needed to be reorganized to avoid entering downtown as a through pass during trips from west to east and vice versa, this is assuring traffic fluidity in the area. Adding to this, increasing the transit capacity in the tunnel by increasing the lanes from 2 or 3 lanes to 3 or 4 lanes.

Thus, the integration between the previously illustrated means of transportation will give the optimum initial solution for the problem of traffic congestion in parallel with a number of suggested actions that will be illustrated in the next section

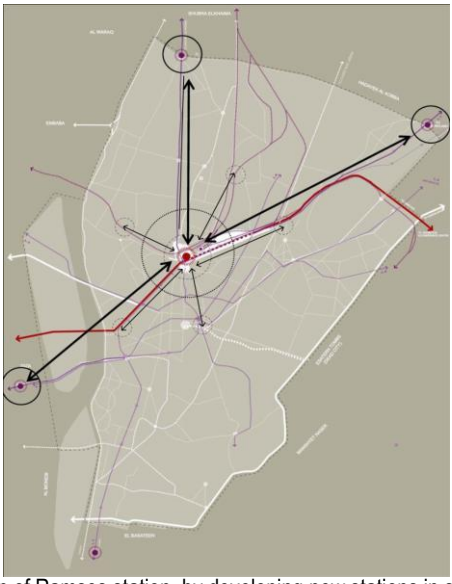

Fig. 5. Decentralization of Ramses station, by developing new stations in suburban (BECT/AREP, 2009)

6.2 Reveal the central midpoint of this site:

Given the importance of Ramses square location, it is suggested to promote the central midpoint of the site to accommodate motion, living, entertainment and restful spaces. Therefore, the following actions should be taken into consideration:

- Limit roads impact
- Optimize motions linked to transport centers
- Reveal existing usages
- Free public space and create central place to pedestrian
- Accompany movements for a new trading offer

Finally, reconsidering the site inter-modality is highly recommended. This can be realized by optimizing the station performance and the interconnection between different means of transportation.

6.3 The final solution of the square as a multimodal transportation hub project:

The final suggested solution of Ramses square is based on benefiting from the tramway line modernization to bring its end closer to the square, modifying the main metro access entrance, positioning it as close as possible to the conveying point of the whole flows and restructuring connections with coach station around a trading arcade.

In Figs. (6-9), it is clearly shown how the rearrangement of multi transportation modes is studied and collected from diffused unorganized to a multimodal exchange point hub

concentrated in the middle of the square and strongly linked with all modes of transportation from all directions, after redesigning most of them, train station, metro station, buses, minibuses, microbuses stops and terminals, car parking, tramway and roads network (including the flyover that is converted to tunnel).

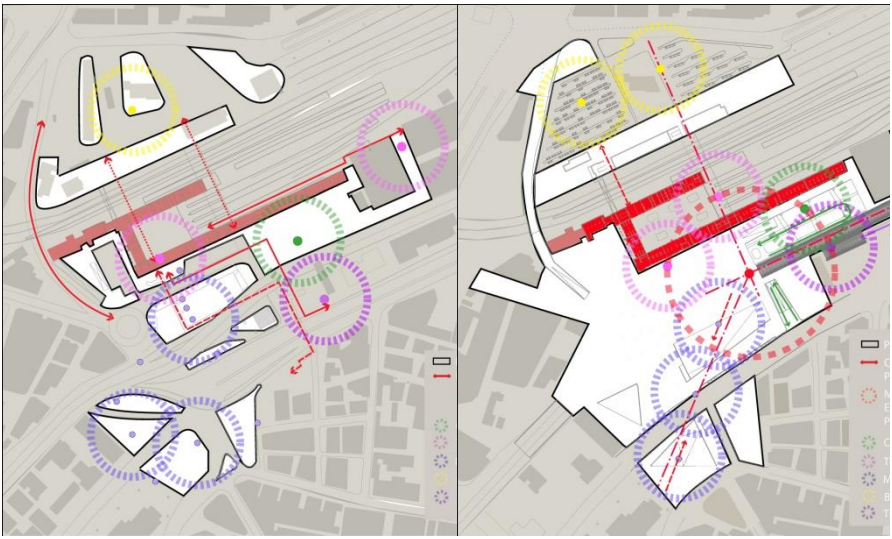

Fig. 6. Ramses square analyses before and after the solution development (BECT/AREP, 2009)

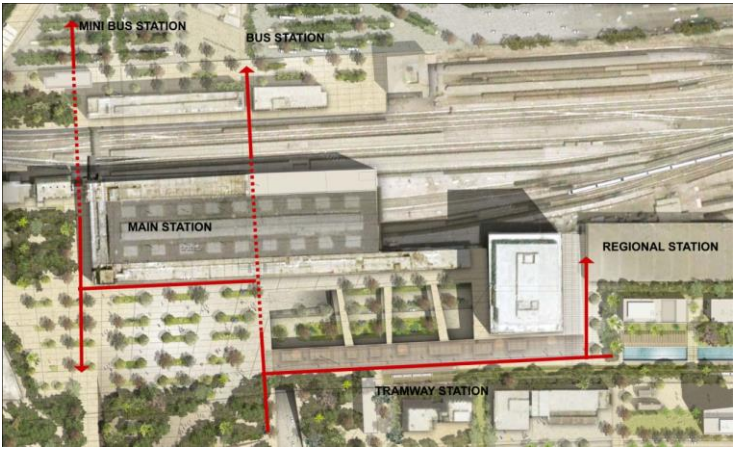

Fig. 7. The final design for the square area (BECT/AREP, 2009)

Fig. 8. Perspective shot and transversal section for the final design for the square area (BECT/AREP, 2009)

Fig. 9 General Perspective shot for the final design for the square area (BECT/AREP, 2009)

7.0 Findings and Discussions

Findings of this research were clearly remarked in the solution of Hubs, that it is highly

needed to integrate multi modal transportation modes in central locations with numerous uses and activities. Within the case of Ramses square, the cuse of Hubs organizes the layers of different modes of transportation to avoid congestion nodes at the square. In further research, it is highly recommended to study how to use Hubs on a grid of cental locations to form absorbtion nodes for traffic congestions and multi modes of transportation in a balanced way allover the highly dense capitals – as Cairo. The use of Hubs can articulate a civilized way of traffic movement through peaceful routes of mobility over all the city sides.

8.0 Concluding Remarks

The main agglomeration of GCR is currently subject to strong congestion and high density. The transportation network of the GCR is today well below international comparisons. It is saturated; congestion is common on the roads and the capacity and coverage of the public transportation network are insufficient to cope with the ever increasing demand. This results in congestion, traffic jams and wasted time and productivity for millions of Cairenes. Looking for non-conventional solutions to resolve the conflict between transportation and urban dynamic of CGR was indispensable. This research focused on transportation hubs (Multi Modal Platforms), as a nodal that can handle several transport modes and more traffic, particularly in busy cities. It then illustrated the case of Ramses square which is located in the centre of Cairo, as an example of a multimodal nodal area, which can be a glary application as a hub solution example. Ramses square is a core for transports; railway, underground metro, surface tramway, major road axis, bus stops, minibus stops, microbus stops and terminals. The illustrated solution is principally based on the integration between several means of transportation; train stations, metro stations, tramway and road network (including the flyover) in order to give the optimum initial solution for the problem of traffic congestion in parallel with a number of complementary suggested actions. It is clearly shown how the rearrangement of multi transportation modes is studied and collected from diffused unorganized to a multimodal exchange point hub. The adopted methodology can be replicated in similar context either in Egypt or in other countries that face same problems of traffic congestion and conflict between urban dynamics and transportation, particularly in central centres of city capitals. It is suggested for further research to study the field of "Hubs networks", where the Hub can be the unit or prototype which be repeated to form a network. This opens the door for a new perspective to deal with the critical problems resulted from traffic congestion in urban agglomeration (city or capital).

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